

CLAIMS

1. A device for thermoforming an object (10) presenting an undercut portion (10B) and a base portion (10C), the device comprising: a thermoforming mold (12; 112) having a base portion (13; 113) and at least two undercut-forming portions (12A, 12B; 112A, 112B) in the vicinity of an open end (12'); a countermold (18; 118; 218) having an end (18'; 118'; 218') that is suitable for co-operating with said end of the mold so as to clamp a piece of thermoplastic material thereagainst and so as to co-operate with said portions of the mold to define a thermoforming cavity (16); and a thermoforming piston (20) that is mounted to move between a thermoforming active position in which it penetrates into said cavity (16) and an inactive position in which it is situated outside said cavity, the two undercut-forming portions of the mold being suitable for being moved apart so as to enable the object to be unmolded;

said device being characterized in that it further comprises holding means (23A, 23B; 223A, 223B, 223C) suitable for holding the object (10) relative to the countermold (18, 118; 218), and in that, in order to unmold the thermoformed object, said portions (12A, 12B; 13; 112A, 112B, 113) of the mold (12; 112) and the holding means (23A, 23B; 223A, 223B, 223C) are suitable for being controlled in a sequence in which the undercut-forming portions (12A, 12B; 112A, 112B) of the mold (12; 112) are moved apart, said holding means (23A, 23B; 223A, 223B, 223C) are active and hold the object (10) relative to the countermold (18; 118; 218), and at least the base portion (13; 113) of the mold (12; 112) is spaced apart from the countermold while the holding means are active.

2. A device according to claim 1, characterized in that the undercut-forming portions (12A, 12B; 112A, 112B) of the mold (12; 112) are constrained to move with the base portion (13; 113) of the mold.

3. A device according to claim 1 or 2, characterized in that the mold (12; 112) and the counter mold (18; 118; 218) are suitable for being moved (e) relative to each other in order to place their respective ends (12'; 18', 118') out of contact before the two undercut-forming portions (12A, 12B; 112A, 112B) of the mold are moved apart.
- 10 4. A device according to any one of claims 1 to 3, characterized in that it further comprises pick-up means (30A, 30B) suitable for picking up the object after it has been unmolded, said pick-up means and the holding means (23A, 23B; 223A, 223B, 223C) being suitable for being controlled such that the pick-up means (30A, 30B) pick up the object (10) while the holding means (23A, 23B; 223A, 223B, 223C) are holding said object against the end (18'; 118'; 218') of the counter mold (18; 118; 218), then the holding means (23A, 23B; 223A, 223B, 223C) cease to hold the object (10) and the pick-up means (30A, 30B) are moved to bring the object out of the thermoforming device.
- 15 5. A device according to any one of claims 1 to 4, characterized in that the holding means comprise holding members (23A, 23B; 223A, 223B, 223C) suitable for being moved between an active position in which they are suitable for holding the object (10) relative to the counter mold (18; 118; 218) and an inactive position.
- 20 6. A device according to claim 5, characterized in that the holding means comprise fingers (23A, 23B) secured to or integral with arms (22A, 22; 122A, 122B) that are hinged to the counter mold (18).
- 25 7. A device according to any one of claims 1 to 6, characterized in that, for the purpose of unmolding the

object, said portions (12A, 12B, 13; 112A, 112B, 113) of the mold and the holding means (223A, 23B) are suitable for being controlled in a sequence in which, in succession, the undercut-forming portions of the mold (12A, 12B; 112A, 112B) are moved apart, the holding means (23A, 23B) go from an inactive position to an active position in which they hold the object (10) relative to the countermold (18; 118), and the base portion (13; 113) of the mold is moved apart from the countermold.

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8. A device according to claim 7, characterized in that the holding means comprise fingers (23A, 23B) which are mounted to move in the join plane in which the undercut-forming portions (12A, 12B; 112A, 112B) of the mold (12; 112) join.

9. A device according to any one of claims 1 to 7, characterized in that the holding means (223A, 223B, 223C) are suitable for taking up an inactive position and an active position in which they define a portion of the wall of the thermoforming cavity (10) and in which they are suitable for holding the object relative to the countermold (218), and in that said holding means are suitable for occupying their active position while the object is being thermoformed, and while the undercut-forming portions (12A, 12B; 112A, 112B) of the mold are being moved apart.

10. A device according to claims 5 and 9, characterized in that the holding members (223A, 223B, 223C) present edge portions (223'A, 223'B, 223'C) which, when said members are in the active position, define, at the end (218') of the countermold (218), a closed outline in which a pellet of thermoplastic material (201) disposed on the end (218') of the countermold can be wedged for the purpose of being thermoformed in order to form said object..

11. A device according to claim 10, characterized in that
the holding members (223A, 223B, 223C) are supported
resiliently relative to the countermold (218) between a
5 wedging position in which, with the mold (12) being
spaced apart from the countermold (218), said members
project beyond the end (218') of the countermold over a
given projection distance (DE), and a retracted position
in which said projection distance is a distance (DF) that
10 is reduced or optionally zero.

12. A device according to claim 10 or 11, characterized
in that each of the edge portions (223'A, 223'B, 223'C)
is provided with at least one anchoring piece in relief
15 (224) for anchoring into the thermoplastic material.

13. A method of thermoforming an object (10) presenting
an undercut portion (10B) and a base portion (10C), the
method consisting in: using a thermoforming mold (12;
20 112) having a base portion (13; 113) and at least two
undercut-forming portions (12A, 12B; 112A, 112B) in the
vicinity of an open end (12'); clamping a piece of
thermoplastic material by means of the end (18'; 118';
218') of a countermold (18; 118; 218) against said end of
25 the mold; defining a thermoforming cavity (16) with said
mold portions; bringing a thermoforming piston (20) into
a thermoforming active position in which it penetrates
into the cavity (16) of the mold from an inactive
position in which the piston is situated outside said
30 cavity; and, in order to enable the object to be
unmolded, moving said undercut-forming portions of the
mold apart;

35 said method being characterized in that, for the
purpose of unmolding the thermoformed object (10), it
further consists in moving the undercut-forming portions
(12A, 12B; 112A, 112B) of the mold apart, and in moving
the base portion (13; 113) of the mold away from the

countermold (18; 118, 218) while holding the object (10) relative to the countermold.

14. A method according to claim 13, characterized in
5 that, while the object (10) is being held relative to the countermold (18; 118; 218), the undercut-forming portions (12A, 12B; 112A; 112B) and the base portion (13; 113) are moved away from the countermold (18; 118; 218).

10 15. A method according to claim 13 or 14, characterized in that, before the undercut-forming portions (12A, 12B; 112A, 112B) of the mold are moved apart, the mold (12; 112) and the countermold (18; 118; 218) are moved relative to each other so as to place their respective 15 ends out of contact.

16. A method according to any one of claims 13 to 15, characterized in that, after unmolding, the object (10) is picked up by pick-up means (30A, 30B), said object 20 ceases to be held relative to the countermold (18; 118; 218), and the pick-up means carrying the object are moved.

17. A method according to any one of claims 13 to 16, characterized in that, in order to hold the object relative to the countermold, holding means (23A, 23B; 223A, 223B, 223C) are moved from an inactive position to an active position in which they are suitable for holding the object (10) relative to the countermold (18; 118; 30 218).

18. A method according to claim 17, characterized in that the holding means (23A, 23B) are moved from their inactive position to the active position after the 35 undercut-forming portions (12A, 12B; 112A, 112B) of the mold have been moved apart.

19. A method according to claim 18, characterized in that, in order to hold the object (10) relative to the countermold (18; 118), the holding members (23A, 23B) are moved between the undercut-forming portions of the mold,
5 as spaced apart from each other.
20. A method according to claim 17, characterized in that the holding members (223A, 223B, 223C) are moved from their inactive position to the active position before the object (10) is thermoformed, and in that said holding members are returned to their inactive position only once the undercut-forming portions of the mold have been moved apart.
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- 15 21. A method according to claim 20, characterized in that the object (10) is thermoformed from a pellet of thermoplastic material (201), and in that, before said object is thermoformed, the periphery of said pellet is shaped by means of the holding members (223A, 223B,
20 223C).